Adequacy of ISO 9000 Certification for DoD Weapon System Software Development Contractors

Let's Put the Emphasis Back Where It Belongs — On Actual Product Quality vs. ISO 9000 Certification

JAMES H. DOBBINS

Suppose the Service Acquisition Authority or the Undersecretary of Defense for Acquisition, seeking to streamline the acquisition process, asked you if you could base your software source-selection decision in large measure on whether a contractor was certified by the International Standardization Organization, or ISO 9000-certified? If you must weigh your response against the knowledge that should the contractor lack ISO certification, then the government would have to perform pre-award certifications against government or commercial standards and specifications, especially for software development contractors, how would you respond? This article seeks to answer just that question.

ISO 9000 and Software Development Contractors

Let's look at the advisability of relying on ISO 9000 certification of software development contractors (specifically ISO 9000-3), in light of a recent memorandum from the Secretary of Defense[1] directing the use of industry standards and specifications on Department of Defense (DoD) programs, and whether such ISO certification would be an adequate substitute for currently existing software development standards.

After review of the various issues involved, I concluded that ISO 9000 *certification* of software developers would not be an adequate substitute for existing software standards and specifications, and further, that reliance on ISO 9000 *certification* would only exacerbate an already serious condition. I based my conclusion on known misconceptions about ISO 9000 certification, as well as the implied significance of such certification.

How It All Started

First, let me recount how the current issue of ISO 9000 certification for DoD Weapon System Software came about. In 1993 a group of industry executives produced a report, at the request of the Secretary of Defense, detailing what should be done to help streamline the acquisition process. One of their recommendations was to eliminate military manufacturing specifications and standards in favor of industry specifications and standards. This led to the formation by the Secretary of Defense of a Process Action Team (PAT) charged with responsibility to come up with an implementing strategy.

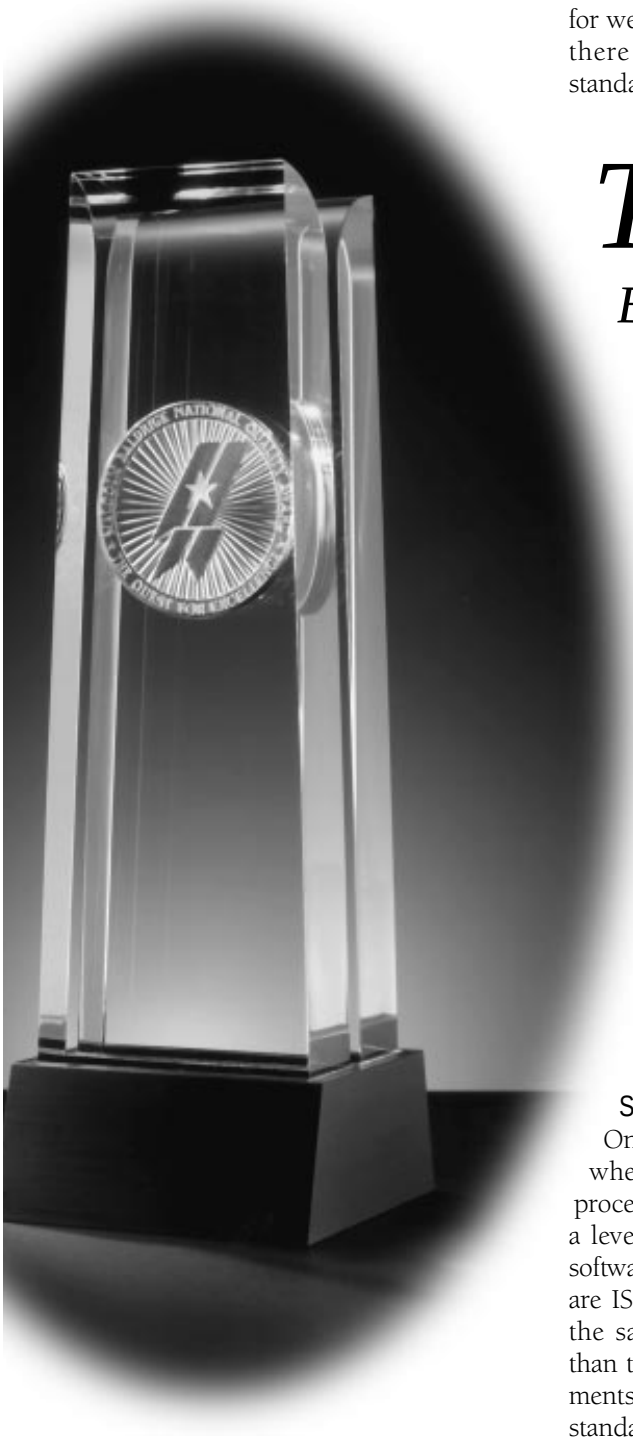
The PAT team produced their report,[2] which was accepted for implementation by DoD. None of the members of this PAT had any software experience other than one person who had some minimal experience with management information systems. This PAT, during their deliberations, and without seeking counsel from experts in the field, concluded that DoD-STD-2167A and DoD-STD-2168 were manufacturing standards, whereas in reality they were processing standards, and that they required priority action for deletion. There was, at this time, no desire expressed by industry executives to do away with process standards. The PAT then recommended, in conformance with industry's report that military manufacturing standards be elimi-

THE MALCOLM BALDRIGE NATIONAL QUALITY AWARD WAS ESTABLISHED BY CONGRESS IN 1987 TO PROMOTE QUALITY AWARENESS, TO RECOGNIZE QUALITY ACHIEVEMENTS OF U.S. COMPANIES, AND TO PUBLICIZE SUCCESSFUL QUALITY STRATEGIES. THE AWARD IS NOT GIVEN FOR SPECIFIC PRODUCTS OR SERVICES. IN COOPERATION WITH THE PRIVATE SECTOR, THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY DEVELOPED AND MANAGES THE AWARD PROGRAM.

Dobbins is the Associate Dean for Information Dissemination, Research, Consulting, and Information Division, DSMC.

nated or converted to performance or nongovernment standards.

On the surface, this seemed reasonable given the difficulty industry has experienced dealing with the confusing array of over 31,000 military standards and specifications, and the unreasonable length and detail of many of the manufacturing standards and specifications. The problem we then faced was that DoD-STD-2167A and DoD-STD-2168 were included on the list of standards to be revoked. The PAT also recommended that Mil-STD-498, Development of Weapon Systems and Information Systems (the successor of DoD-STD-2167A) not be issued; that DoD-STD-499B, Engineering Management, not be issued; and that Mil-STD-499 be deleted. The DoD software acquisition community was thus left without an adequate military standard for weapon systems development, and there was no appropriate industry standard.



The Malcolm Baldrige criteria are much broader than the ISO 9000 criteria, and offer more in the way of overall contractor maturity.

Setting the Record Straight

One issue which merits attention is whether the ISO 9000 certification process is rigorous enough to provide a level of assurance to the DoD that software, developed by companies that are ISO 9000-certified, would possess the same or higher levels of quality than that produced under the requirements of pre-existing military software standards identified above.

Before we can make any determination as to whether requiring ISO 9000 certification for DoD software development contractors is desirable or even meaningful, and to put this into proper perspective with other quality-related activities, we have to understand what ISO 9000 *certification* really means.

Many people in the DoD assume that being ISO 9000-certified means that the products produced will be high-quality products. Likewise, many in industry are operating under the mistaken belief that the DoD now requires companies to be ISO 9000-certified. This is decidedly not the case on both counts.

A DoD spokesperson, Beverly Baker, set the record straight. Although it was reported in the trade press, it seems few have gotten her message that, "ISO 9000 will not be our standard of choice. Contractors who want to do business with the military can use military, other national, or ISO 9000 specs." Since so many in industry seem to have been moving swiftly toward ISO 9000 certification, the ambivalence of Baker's statement might seem surprising to some, but it was a well-considered position, especially for software development.

To understand the position she has articulated, and my assertion that ISO 9000 certification in no way equals pre-existing military software standards, it is necessary to understand what ISO 9000 certification could mean, and some of the implications of current activities here in the United States and in Europe.

What Does ISO Certification Mean?

One thing that is very important to understand is that ISO 9000 certification means little more than the company's affirmation that it does what it says it does. This means, as Richard C. Buetow, Motorola Director of Corporate Quality, has said with only slight exaggeration:

Photograph by Steuben, provided courtesy of the National Institute of Standards and Technology (NIST), Gaithersburg, Maryland.

> With ISO 9000 you can still have terrible processes and products. You can certify a manufacturer that makes life jackets from concrete, as long as those jackets are made according to the documented procedures, and the company provides the next of kin with instructions on how to complain about defects.

Nationalization vs. Globalization

Many of the companies DoD selects as contractors are global, not just multinational. They truly are, as one Ford executive indicated, a collection of little companies operating under one name. In this shift to globalization, international boundaries assume a seamless character, leading to an issue of nationalization versus globalization. Companies are beginning to question, given that ISO 9000 is becoming a global standard, whether national bodies should be the players creating the standard. They are asking who the real players should be; perhaps the global companies themselves.

It is also uncertain at this time whether the former Eastern Block, Russia, Japan, China, and other Pacific Rim countries will all come on-board with ISO 9000, or if we will see some sort of standards war coupled with resultant trade wars. The United States is trying to circumvent this possibility through programs administered by the National Institute of Science and Technology (NIST). As a result, NIST has established successful pilot programs in Saudi Arabia, and has proposed a similar program for Russia.

The Latest Fad or a Quest for Market Advantage?

The impetus for ISO 9000 certification is still confused. Many managers rushed immediately for ISO 9000 certification, just as they have grasped for every other quality initiative that has come along; everything from Total Quality Management (TQM) to Statistical Process Control, Deming, Juran, Crosby, Zero-Defects, and others. It is not the quality they seek, but the perceived market advantage signified by the certification. It is the paper they want to hang on their wall, not development of quality products for their customers.

What is seen by many as just the latest fad, is also seen by others as a ticket into the European Union (EU), formerly known as the European Community (EC). In fact, it is true that some EU companies will not do business with companies who are not ISO 9000-certified. However, in spite of this apparent acceptance, the stark reality is that companies are often looking for ways to avoid the costs of repeated audits of suppliers, or are using the certification as a trade barrier of sorts, or both. The presumed acceptance of ISO 9000-certified companies into the EU marketplace has been hampered by the nationalistic motivations of the member countries, which in turn has emasculated the reciprocal agreement process that should have been firmly established two years ago.

The long-term anticipated effect is that as companies rush to become certified, and as the body of certified companies becomes very large, the market advantage of certification will disappear and contracts will be awarded on cost as the primary driver, not product quality. The impetus for certification may, in fact, already be losing steam. An Amsterdam polling firm, Inter/View, surveyed 423 companies representing a statistical universe of 80,000. Of the small businesses responding, only 27 percent considered the ISO 9000 certification a business requirement. These 27 percent gave, as their reason for pursuing certification, customer demand or market advantage, not product quality. Of the large businesses surveyed, 49.7 percent cited customer demand, and 37.2 percent cited marketing advantage.

The intent of the standard — product quality — has been overshadowed by the perceived market advantages of certification. The result is that small companies complain of bearing the cost, and others are advising companies to hold off on certification. Dean

ISO 90 Assurance

Why was the International Standardization Organization (ISO 9000) series developed? In a shifting global market, both domestic and international companies found themselves required to meet many quality standards for different countries that were conflicting, in different measuring units and management systems that were usually quite confusing.

As part of its strategy to meet this and other geo-political economic challenges, the European countries agreed to form a European Community (EC). From the outset, the EC needed acceptable Quality System Standards for products and services for their customers and suppliers. The ISO, seeking to eliminate some of the confusion, convened to develop an international quality system standard.

In 1985 they agreed on a Resolution that all products produced and sold to the public for which an ISO directive was written, would conform to the quality system standards of the ISO, and be duty-free for acceptance throughout the EC. The ISO 9000-series standards were subsequently issued in March 1987, and covered the essential requirements for good and efficient business management.

The technical specifications included in the ISO 9000 series were not mandatory, nor were they very specific in application

00 International Quality Standards — A Brief History

JULIUS HEIN

and implementation. Maintaining certification to the specifications was also not mandatory. Manufacturers, in essence, were given two choices. They could either:

- conform to the ISO 9000 directives; or
- prove that their products conformed to the essential quality method requirements.

The ISO 9000-series standards have since become the most accepted and used standards in the world. The EC mandated that industries actively engaged in health, public safety, and environmental issues possess certification to the ISO 9000-series standards, as determined by industry-specific directives. Many customers now push industries to become certified. The ISO 9000 series consists of five parts:

ISO 9000, Quality Management and Quality Assurance Standards — Guidelines for Selection and Use
When a business desires to apply for ISO registration, this document provides guidelines as to which document to use and how to use it. A business can apply and register under ISO 9001, ISO 9002, or ISO 9003, depending on the nature of its business structure.

ISO 9001, Quality Systems — Model for Quality Assurance in Design/Development, Production Installation, and Servicing
This is the most complete model for quality assurance systems. The 20 quality system elements listed below are the 20 mandatory requirements of the standard. ISO 9001 is for businesses that include the design function of the product after the sale.

Section 4.1 Management Responsibility
Section 4.2 Quality System
Section 4.3 Contract Review
Section 4.4 Design Review
Section 4.5 Document Control
Section 4.6 Purchasing
Section 4.7 Purchaser — Supplied Product
Section 4.8 Product Identification and Traceability
Section 4.9 Process Control
Section 4.10 Inspection and Testing
Section 4.11 Inspection, Measuring, and Test Equipment
Section 4.12 Inspection and Test Status
Section 4.13 Control of Non-conforming Product
Section 4.14 Corrective Action
Section 4.15 Handling, Storage, Packaging, and Delivery
Section 4.16 Quality Records
Section 4.17 Internal Quality Audits
Section 4.18 Training
Section 4.19 Servicing
Section 4.20 Statistical Techniques

ISO 9002, Quality Systems — Model for Quality Assurance in Production and Installation
This standard is to be used when conformance to specified requirements is to be assured by the supplier during production and installation. It also includes the final inspection and test requirements of ISO 9003 and adds the servicing element from ISO 9001.

ISO 9003, Quality Systems — Model for Quality Assurance in Final Inspection and Test
This standard is to be used by the supplier only for final inspection and test. Certification to this standard is not widely used.

ISO 9004, Quality Management and Quality Systems Element — Guidelines
Along with ISO 9000, ISO 9004 is also an advisory document. This standard is a handbook for implementation of quality management and the quality system elements. The implementation of the guidelines in ISO 9004 is not mandatory for certification. The standard provides detailed advice to businesses on how to manage the overall quality system elements given in the ISO standards. It also provides detailed advice on the intent of elements listed in ISO 9001, 9002, and 9003. ISOs 9004-1 and 9004-2 were published in 1993: ISO 9004-1 explains the ISO 9000 series for manufacturing, while ISO 9004-2 explains the standards for the service companies.

Editor's Note: Hein is the Director, Central Region, DSMC. He holds a B.M.E. from Ohio State University, an M.S. from the University of Missouri at Rolla, and a D.P.A. from Nova University. He is a registered Professional Engineer and a Professional Engineering Manager.

Beachler, chairman of the National Tooling and Machine Association standardization committee said, "ISO 9000 is not necessarily a ticket to exporting, nor is lack of certification proving to be as much a detriment as earlier supposed. It isn't true you need ISO 9000 absolutely to compete globally, and we can offer up thousands of examples."

Quality Reality or Quality Scam?

On closer examination, another agenda surfaces. The rush toward ISO 9000 certification has been ostensibly to gain access to the EU market. This may, in fact, have been the prime motivation for many companies. However, when the veil is pulled back, another picture emerges. The ISO certification process is very costly and time-consuming. Many American companies have come to the conclusion that the ISO 9000 certification requirement is more a trade barrier than anything else. Little value-added is seen by achieving certification, and many companies are now taking a second look at this whole thrust.

Although it was touted as the means to open up the EU market to American and other non-EU companies, the European Commission (EC) official in charge of quality policy, Antonio Salve Mendes, has indicated otherwise. He wrote a 10-page report entitled, "Elements of a Community Quality Policy." In this report, Mendes noted that in spite of the widespread acceptance of ISO 9000 by European companies, those companies still lag the Americans and Japanese in product quality. He wrote, "There is one thing which our competitors...(particularly Japan and the United States) are handling effectively: quality, in the broadest sense of the word." One must therefore ask, if the EU is concerned about product quality from the European companies, and if they acknowledge the higher quality of products from their competitor countries, then why would they be so eager to open the EU market to products of American and Japanese companies, when the quality of those products is so clearly superior?

Is ISO 9000 certification quality reality, or is it a quality scam? Why are the EU countries staying with ISO 9000 if it is not producing a quality advantage for the EU companies? Time will tell. I can say from personal experience, having participated on a Technical Committee (TC) to produce an ISO standard, the TC members representing the different nations are very reluctant to incorporate any requirement into an ISO standard that their nation will have difficulty meeting. Individual national interests drive the content. Therefore, the requirements are a minimal set, which all the national representatives agree should be the content.

EC — Stepping Back and Changing Direction

The EC has also taken steps recently to downplay the importance of ISO 9000 certification. Recognizing that the ISO 9000 certification process has become big business, and that the whole system reeks with conflict of interest and the potential for fraud, and that it is the certification and not product quality that has become the focus of attention, the EC is taking a step back and changing direction — a move that is causing the ISO itself to gasp in disbelief.

The EC is advocating a shift in emphasis to quality products and processes and away from certification. The whole industry that has grown up around the certification process — the consultants and trainers who have been making huge sums in what some describe as an ISO 9000 feeding frenzy — are now looking at the possibility of their whole business basis going down the tubes almost overnight.

It is significant to note that those who are pushing hardest for ISO 9000 certification, and who are creating the most pressing arguments of a fear-based need for certification, are the companies who do the certifying, not the governments or customers. Supplier companies are beginning to complain about non-certified customers requiring certification of their suppliers, presumably to avoid having to conduct regular supplier audits. This new EC thrust has taken shape as described in Mendes' report, "Elements of a Community Quality Policy," cited previously in this article. This report calls for "creation of a pan-European quality program uniting the public and private sector. Although the ISO 9000 standards would be used as a basis for the program, the ISO 9000 certificates would be de-emphasized."

Exceeding ISO 9000 Requirements

Leading American companies have recognized their quality leadership for some time. They have acknowledged that ISO 9000 offers nothing in terms of value-added, and that their quality assurance systems currently in place far exceed the ISO 9000 requirements. Boeing Commercial Airplane Company, for example, does not accept ISO 9000 certification as sufficient to be classified as a Boeing supplier, but has indicated the certification does help in passing the Boeing Basic Quality System evaluation. Those companies who are already Boeing suppliers are not affected by the ISO 9000 registration emphasis. They have already passed evaluation criteria considerably more stringent than ISO 9000 requirements.

Disincentive to Improve a Decided Drawback

One of the least understood drawbacks of the ISO 9000 certification process is the built-in lack of incentive to improve, or more particularly, the disincentive to improve. It is not immediately evident, but according to the way the ISO 9000 certification process is set up, a company that reaches certification receives a certificate that is good for three years. After three years it must be completely recertified. In the interim, the company is checked every six months. But the real concern is that once the company processes are certified, "if a company changes a specific process, it will have to be certified...discouraging attempts to change or update existing processes."

In short, a company committed to ISO 9000 certification may find itself

unable, due to the recertification and interim review costs involved, to implement a continuous improvement program that affects existing certified processes. The result is the death of any entrepreneurial initiative the company may have had.

ISO A Quality Lowest Common Denominator?

Another result of reliance on ISO 9000 certification will be less tendency on the part of the customer to exercise quality oversight of suppliers. Recognizing that ISO 9000 establishes the minimally acceptable criteria, meeting ISO 9000 requirements does not say very much for superior quality. In fact, even with full compliance and with all good intentions on the part of those implementing ISO 9000, the standards offer little other than a quality lowest common denominator.

Certification also tends to cause ignorant customers to award supplier contracts, largely on the basis of cost, to certified companies. This will become commonplace if the majority of companies become ISO 9000-certified and the certification ceases to provide the market advantage it once did. If three bidders are all ISO 9000-certified, the tendency will be to award the contract to the lowest cost bidder, largely based on the unrealistic assumption of what the ISO 9000 certification really signifies in terms of product quality.

This lowest cost award tendency is a potential reality within DoD as well as the DoD contractor community, unless it is well understood by the acquisition community at all levels that ISO 9000 certification is by no stretch of the imagination synonymous with high product quality. Therefore, there will be a double-whammy against which DoD will have to protect itself: no incentive for process improvement on the part of contractors, and a tendency on the part of DoD procurement officials to award contracts based on cost because of presumed levels of product quality guaranteed by the ISO 9000 certification of contractors.

One player in this field likens the ISO 9000 certification process to the Wizard of Oz being able to give the scarecrow his brains.

Current Process a Significant Departure from Initial Conception

The ISO 9000 certification process is hardly conducted in the way it was originally intended. The original thought, and the current assumption of many, is that an American company, once certified, will have automatic entry into the European market. That is how it was intended to work, but is not how it does work. One player in this field likens the ISO 9000 certification process to the Wizard of Oz being able to give the scarecrow his brains.

Companies who are crowned with the certification have usually paid large sums for an outsider with dubious qualifications to tell them what they already knew about what they already had in their quality process. What is worse, the certification may be meaningless in Europe. Instead of the certification being accepted generally in the EU as was the original intent, it has become nationalized, and the certification granted by a given registrar may be accepted by only one country in the EU, or even none.

Mutual recognition agreements between the EU countries have not been signed, so a registrar considered acceptable by Britain, for example, may not be accepted by France or Germany. Recognition agreements between the EU countries and the United States are even farther away. A company that has acquired certification from a registrar recognized by Britain may have to seek recertification, with all of the attendant costs, from other properly recognized registrars, to operate in France or Germany. This is in addition to the situation where, "there is a 60- to 70-percent, first-time failure rate" for those seeking certification.

Small companies are clearly at a major disadvantage, and are in many cases being pushed to obtain certification by large companies who are not themselves certified. Clearly, the interest is not product quality, but rather reduction in acquisition costs due to the presumed need for fewer supplier audits. The responsibility for quality is shifted to the ISO 9000 certification process, not retained by personnel in the companies producing the product or acquiring the product.

Lack of Regulation of the Certification Process

Another problem is the lack of regulation of the certification process. To begin with, instead of a general recognition of registration among EU countries, as was the original intent, each individual country has been obligated to appoint a recognized body to be the regulator of ISO 9000 registrars, and the requirements differ from country to country.

Companies that are focused on the certification itself and have not done their homework can easily select a registrar not accepted by any country. Companies that are global and do business in many countries may have to incur the registration costs for each EU country in which they intend to operate. This virtually eliminates small companies altogether from participation in the market.

Each registrar interprets the standard without any governance to determine if their interpretation is valid. A major complaint with the standard is vagueness, and the lack of specificity means that companies are at the mercy of the registrar, registrars being the only ones authorized to interpret the standard. A common complaint of companies is the wide variance of interpretation by different registrars.

In the United States, the government has not appointed a licensing agent, opting rather to let the American Society for Quality Control (ASQC) establish the Registrar Accreditation Board (RAB). The RAB, although in existence for over three years now, has still not received the desired consensus approval from the EC, leaving a cloud over the heads of the RAB-certified registrars.

To complicate matters, many registrars in the United States do not receive registration by the RAB, but rather by licensing bodies in other countries. To make matters even worse, in the United States, "an organization (or person) can simply declare itself a registrar — a situation that is legally prohibited in Europe." The problem is further complicated by the consulting side of the picture. Most companies hire a consultant to help them get ready before the registrar comes in for the audit.

Although the certification process for registrars is lax, the process for consultants is nonexistent. Anyone, with no qualifications at all, can advertise that they are an ISO 9000 consultant, and in today's market will probably have many clients. In 1993, the National ISO 9000 Support Group conducted a survey of 660 ISO 9000 consulting firms, and found that only 111 of those had any formal assessment training.

Certified Public Accountants and ISO 9000

Finally, to further complicate the matter there is a big push on among Certified Public Accountant (CPA) firms to become ISO 9000 registrars and consultants. They reason that since their job is auditing, and the ISO 9000 certification process is an audit process, they should be eminently qualified for this task. No mention is made of subject-matter expertise or domain knowledge within a given subject area. To these proponents, an audit is an audit, and it represents a large potential source of income, especially from ignorant potential customers.

In my opinion, to allow a CPA firm to conduct a certification on a defense software contractor, and then award a weapon system software contract based on that certification, or give any credence to that assessment, is tantamount to playing contractual Russian roulette. Simply stated, CPAs do not generally have the subject-matter expertise to provide the kind of assurance needed by DoD, where the software is going to provide the functionality for weapon systems on which our fighting forces are going to risk their lives. It may be a large potential source of income for a CPA firm, but I do not think it is worth the risk to DoD to rely on such an assessment.

Let's Look at the Whole Picture

Given all that, we need to assess where we are in DoD and what we should be requiring of our software development contractors. From the above, it might sound like ISO 9000 is not the answer, at least not for software. The real answer is, it depends. We need to look at the whole picture, and when we do we see that there may be a place for ISO 9000-compliant companies in the software acquisition process, not because of certification but because of what they have done to comply with ISO 9000 quality requirements. The certification itself is something DoD should de-emphasize.

It is important to look at the issue from three different perspectives. One is the ISO 9000 standard; another is the Software Engineering Institute (SEI) Capability Maturity Model (CMM); and the third is the Malcolm Baldrige National Quality Award criteria.

SEI Model. It makes sense to begin with the SEI model since this forms a sort of hub within which the other two can be seen to fit, and in relation to which each of the other two makes some sense. The SEI, a federally funded research and development center located at Carnegie-Mellon University in Pittsburgh, was tasked by DoD with determining why some companies seem to consistently be able to produce good software, while the performance of others, the majority, was totally unpredictable.

Capability Maturity Model. The SEI conducted a major research task, which resulted in the publication of the Capability Maturity Model. The CMM shows that the key to production of good software is institutionalized good processes, not individual skills, and that there are specific processes that must be incorporated.

Further, they found that the processes have a hierarchical dependency. This means that it is not enough for a company to develop the correct processes, but that they must develop those processes in a hierarchical order if the desired benefits are to be derived. The process maturity is evaluated on a scale from one to five, now designated by name rather than number.

Level 1. What the SEI found was that companies at Level 1, the Initial level, operate in an ad hoc manner, and have no process dependency.

Level 2. Companies at Level 2, the Repeatable level, have institutionalized four processes. Those are Project Management, Project Planning, Software Quality Assurance and Software Configuration Management.

Level 3. Companies at Level 3, the Defined level, must have institutionalized, in addition to all the processes at Level 2, the four additional processes of Training, Peer Reviews, formation of the Software Engineering

Process Group, and establishment and institutionalization of internal Software Standards and Procedures.

Level 4. Companies at Level 4, the Managed level, must demonstrate the institutionalization of the two additional processes of Product Quality Management and Process Measurement and Analysis.

Level 5. Companies at Level 5, the Optimized level, must demonstrate the additional processes of Process Improvement and Defect Prevention.

What has all this got to do with DoD software development and ISO 9000 certification? When the SEI did their initial analysis of the DoD contractors, they found that almost 87 percent were at Level 1; in 1992 they found that 81 percent of the companies surveyed were still at Level 1, and slightly over 1 percent were at Level 3. Only three projects, not facilities, in the world are managed at Level 5. Two of these are in the United States. One facility, Motorola-India, was recently assessed at Level 5.

This picture means that there is a high likelihood of a Level 1 software company being awarded a contract, and this presents an extremely high risk to the DoD program manager. There are simply not enough Level 3 and 4 companies to go around. However, if the ISO 9000 standard is invoked, not by requiring certification, but by requiring that the software processes included be implemented and used in conjunction with Mil-STD-498, this would result in a process maturity equivalent to a high Level 2 — one which is approaching Level 3 maturity. This could be very important because under the current system of acquisition, DoD cannot require a particular SEI level of maturity of the contractor. The lower the maturity level, the higher the risk; the higher the maturity level, the lower the risk.

The Malcolm Baldrige criteria are generally those that focus on process maturity, customer satisfaction, process measurement and control, top management involvement and commitment, and other types of criteria that one would expect to see at the higher levels on the SEI maturity scale.

This could be the impetus many companies need to begin to improve their process maturity and lower the risk to the government acquisition community. Note that ISO 9000 certification is not the issue here, but rather invoking the quality process requirements of the standard. Certification is irrelevant. The fact that the processes have been implemented should be established by a pre-award audit conducted by the government, not by a registrar with dubious credentials.

Hughes Aircraft in Fullerton, California, spent $450,000 over two years to go from SEI Level 2 to Level 3. However, they determined that as a result of that one-time investment to reach Level 3, they were saving approximately $1.2 million dollars annually thereafter. This is in contrast to the ISO 9000-required investment of approximately $250,000, and the three-year average period to recover that investment.

Malcolm Baldrige National Quality Award Criteria. If DoD desires to go beyond Level 2, however, and many program managers feel it would be a significant advantage to have a contractor at a solid Level 3, then it is moving into a maturity level sphere where ISO 9000 falls by the wayside. What begins to surface at Level 3 through 5 is a maturity consistent with the requirements generally expressed in the Malcolm Baldrige award criteria.

Several software development companies that have applied for the Malcolm Baldrige award have described their adoption of the SEI maturity model as the means chosen to improve their software quality process. While parts of the individual Baldrige criteria generally change each year, the required level of process quality maturity necessary to meet the objectives stated is fairly consistent.

The Malcolm Baldrige criteria are generally those that focus on process maturity, customer satisfaction, process measurement and control, top management involvement and commitment, and other types of criteria that one would expect to see at the higher levels on the SEI maturity scale. The Malcolm Baldrige criteria are much broader than the ISO 9000 criteria, and offer more in the way of overall contractor maturity.

This means that if DoD desires to contract with companies to develop software for weapon systems, intelligence systems, command and control systems, and other complex systems; and a process maturity at SEI Level 2 or a little higher is desired, the ISO 9000 standard requirements might be an appropriate option to consider, provided the focus is on the content and not on certification, and provided the government or a properly qualified agent performs the pre-award audit.

Internal Standards Equal or Better

We must also be willing to step back and recognize there is nothing inherently wrong with current systems developed by leading contractors under the guidelines of DoD-STD-2167A, or systems based on TQM or

continuous process improvement. Just because a new initiative has come along in ISO 9000 does not mean the other existing systems are deficient. Many multinational companies, such as Boeing, developed internal standards based on the military standards, and then sought to improve the standard even further as their software development processes matured.

Even if DoD-STD-2167A and DoD-STD-2168 are not available any more, the software development systems of contractors based on these standards, and improved upon over the years, are still good systems, and are commercial systems. If a company offers to use such an internal system, it should be acceptable to DoD. However, it will require sufficiently knowledgeable government evaluators to determine the suitability of the contractor system during pre-award audits.

Mil-STD-498 and Its Commercial Equivalent

One more consideration affects this picture. At the beginning of this article, I indicated that the PAT[3] had recommended that Mil-STD-498[4] not be issued. Since that time, several people became concerned about the effect of not having an adequate software development standard for DoD weapon systems. The Defense Science Board expressed concern, as did the Software Management Review Board (SMRB), with this situation.[5]

At the SMRB meeting in September of 1994, chaired by John Burt, the Deputy Undersecretary designee, this concern was expressed, and the SMRB took responsibility for getting Mil-STD-498 signed out as a process standard. Upon issuance of the standard, the Institute of Electrical and Electronics Engineers (IEEE) issued a Project Action Request to develop a commercial equivalent standard. As soon as this IEEE standard is issued (targeted for July 1996), Mil-STD-498 will be deleted. The DoD will then invoke the new industry standard on contracts. Mil-STD-498 was signed out and made available to all parties concerned. The Navy and Air Force have issued blanket waivers to use Mil-STD-498, but the Army has not, thereby further complicating the picture, especially for joint programs.

Other Developments Complicate the Issue of a Replacement Standard

Since the time Mil-STD-498 was signed out, other developments have come about that add a layer of complication to this picture. The intended IEEE replacement standard, IEEE-STD-1498, may not be issued. The most current objective is to focus attention on issuing ANSI-STD-016, which will be ISO-STD-21207, Software Life-Cycle Management,[6] as is, with a USA-tailored annex. This annex will contain much of the good technical content of Mil-STD-498.

This new standard, ANSI-STD-016, will probably not be issued until December 1996. If successful, then IEEE-STD-1498 will not be issued. It is also anticipated that ISO 9000-3 for software will have one minor revision and then will be canceled in favor of ISO-STD-21207. This is one more major reason not to rely on ISO 9000 certification for software contractors.

Why All the Fuss?

One might wonder, why all the fuss over ISO 9000 if Mil-STD-498 is signed out and will eventually be replaced by an equivalent industry standard. Similar in scope to DoD-STD-2167A, Mil-STD-498 focuses much more on process. The standard requires that a contractor have documented processes covering software development, software quality assurance, configuration management, and the like, but still emphasizes the documentation and products to be delivered.

As long as they are tailored properly so as not to create a conflict between them, I would consider invoking both Mil-STD-498 and ISO 9000-3 for as long as ISO 9000-3 survives, especially if the program is a large joint program, and definitely where any European companies or countries will be involved. But again, I would not impose any requirement for certification; just compliance under the contract with the requirements of the standard. The government, as the customer, can be the best interpreter of the standard for its contract purposes. Upon issuance of ANSI-STD-016, the issue is considerably simplified.

DoD and the Malcolm Baldrige Criteria

One more point needs to be addressed regarding this whole ISO 9000 certification question. I have repeatedly indicated in this article that certification is not the issue, but rather compliance with the product quality objectives. Accordingly, DoD should begin to focus more on the Malcolm Baldrige criteria, and begin to invoke these criteria on contracts. Naturally, this could not be done all at once. The Malcolm Baldrige criteria, as a collective set, are those met by very few companies. But the criteria could be introduced a little at a time and made a part of the acquisition source selection criteria.

Over time, the entire set of criteria could be incorporated, tailored of course for the needs of individual programs. Since the Malcolm Baldrige criteria are at a considerably higher process maturity level than ISO 9000; and if our desire is to have companies continue to improve processes and become more mature; and to have top management in companies become more committed to product quality, it seems natural that we would gradually begin to invoke the Malcolm Baldrige criteria.

It would clearly be an advantage to DoD to have companies operating in compliance with the Malcolm Baldrige criteria, and would certainly give American companies a competitive advantage both here and abroad, an advantage not enjoyed by mere ISO 9000 compliance, certified or otherwise. If the Malcolm Baldrige criteria were gradually introduced into the DoD acquisition process, it would spur foreign companies doing

business with DoD to improve their processes both in depth and in scope.

It would soon become obvious that a company which is Malcolm Baldrige-compliant is clearly operating at a level considerably higher than that required by ISO 9000, and should not be required to have ISO 9000 certification. If the United States was to require such compliance of foreign companies operating in the United States, the U.S. reputation for quality would soar much higher than it ever could under ISO 9000 compliance requirements. To do this, however, a DoD-tailored process for evaluation has to be devised.

As I See It

Having taken several pages to tell you that the fundamental answer to the question posed in the opening paragraph of this article is "No," I will try to outline for you what should be done.

- The ISO 9000 standard, particularly ISO 9000-3, should be invoked on software development contracts, without any regard whatever for whether a bidding company is or is not certified.

- The Mil-STD-498 should be invoked on all software contracts, regardless of whether they are weapon systems development contracts or contracts for management information systems, and the Army should be encouraged to adopt this standard. The standard was designed to be used for development of both types of systems. Naturally, the standard must be tailored for use in accordance with the needs of the contract.

- Specific metrics should be invoked so that adequate visibility into the development process can be obtained during each life cycle phase by both the government and the contractor program managers, without being an undue burden on the personnel producing the product. The metrics should be a combination of those identified by the government in the Request for Proposal (RFP) and those identified by the contractor in their proposal response.

It would soon become obvious that a company which is Malcolm Baldrige-compliant is clearly operating at a level considerably higher than that required by ISO 9000, and should not be required to have ISO 9000 certification.

- The Computer-aided Software Engineering (CASE) tools should be identified by the contractor, not imposed by the government. Also, CASE tools should match the process maturity of the contractor (obviously the government does not know who the contractor will be when the RFP is first issued).

- The contractor quality assurance plan should identify the relationship between the internal company standards, quality plans and procedures, and the requirements of ISO 9000-3 and Mil-STD-498.

- Testing requirements identified in ISO 9000-3 and Mil-STD-498 should be augmented by the peer review process required for SEI Level 3.

- ANSI-STD-016, once issued, should be used in place of the ISO 9000-3 and Mil-STD-498 standards.

As the acquisition process is modified under the acquisition reform initiative currently underway, consideration should be given to begin incorporating the Malcolm Baldrige criteria as part of the source selection process. This will have to be done gradually over time. If done properly, it should drive the contractor and government community toward higher quality processes across the board, and should eventually serve as the major discriminator in contract award and a major requirement for joint programs and for multi-national programs.

Editor's Note: Dobbins welcomes questions or comments concerning the issues and recommendations surfaced in this article. He may be contacted as follows:

Commercial: (703) 805-2525
DSN: 655-2525
Internet: dobbins_jim@dsmc.dsm.mil

ENDNOTES

1. Memorandum from William J. Perry, Secretary of Defense, "Specifications and Standards - A New Way of Doing Business," June 1994.

2. Report of the Process Action Team on Military Specifications and Standards, April 1994, issued by the Office of the Under Secretary of Defense for Acquisition and Technology.

3. Ibid.

4. Memorandum from R. Noel Longuemare, Principal Deputy Under Secretary of Defense for Acquisition and Technology, "Report of the Defense Science Board Task Force on Acquiring Defense Software Commercially," July 26, 1994.

5. Mil-STD-498, Software Development and Documentation, November 1994, superseding DoD-STD-2167A, Mil-STD-7935A, and DoD-STD-1703(NS).